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STUDIES IN VIOLA.—I.

Proposed Segregates of Viola.

BY J. A. NIEUWLAND AND R. M. KACZMAREK.

The presence or absence of cleistogamous flowers in plants has become more and more recognized as a basic character for classification. The genus *Crocanthemum* of Spach,[1] lately recognized[2] by Dr. Britton as the name applicable to our American Rock Roses or Frostweeds has as perhaps its most important character of distinction from *Halimium* and *Helianthemum*, the presence of the less conspicuous cleistogamous flowers. In a closely allied family, the *Violaceae*, in the genus *Viola*, these flowers serve no unimportant part in differentiating species from one another. As the presence or absence of them seems to be a constant character in the plants mentioned we can see no reason why further segregation of the old aggregate genus *Viola* may not be suggested with reason, all the more as there are very important characters of cleistogamous flowers, and the habit of the plants in question demands serious consideration of the matter. In fact Spach and others before and after him without reference to presence of cleistogamous flowers thought the various groups now aggregated under *Viola* as sufficiently different from one another to constitute natural genera. Even before Linnaeus and by some after him, the Pansies were grouped by themselves. As already intimated in a former article by one of us[3] not only are these flowers present constantly in some groups with other important differential characters, and absent in others, but when present, there are important characters of distinction in these cleistogamous flowers themselves.

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[1] Spach, E., Am. Sci. Nat. II. 6, p. 370, (1836); also Hist. Nat. Veg. VI., p. 95, (1838).

[2] Britton, N. L., Ill. Fl. N. U. S. II., p. 539, (1913).

[3] Nieuwland, J. A., Am. Mid. Nat. III., 3, p. 85–91. (p. 90).

During the past season particularly, and in fact for nearly a decade past, this interest in the apetalous flowers was maintained by us. Though not a great number of individual species has as yet been examined, in every one of the groups it has been found that *e. g.*, acaulescent violets including, the white violets such as *V. lanceolata*, *V. primulaefolia*, *V. blanda*, *V. incognita*, have uniformly, as far as examination of their cleistogamous flowers was made, two fertile stamens, with occasionally the presence of a very small abortive petal or two, as in case of *V. cucullata*. The solitary abortive petal is usually the keel, or lower petal. The other petals and stamens are represented if at all as minute processes like small stiped capitate glands, found in their regular positions with respect to the more or less equal sepals.

The caulescent violets represent three groups. The pansies which are annuals, biennials or winter annuals, have no cleistogamous flowers. *Viola eriocarpa* Schwein (*Viola scabriuscula* Schwein) and *Viola pubescens* Ait., have subequal sepals and only two stamens in their apetalous summer flowers. *Viola canadensis* Linn., *Viola rostrata* Pursh, *Viola striata* Ait., have five fertile stamens in their cleistogamous flowers. The first of these does not produce these flowers until very late in the season and then the transition from petaliferous to apetalous ones is a rather gradual process. The petals become gradually smaller and finally disappear completely, one or several at a time. The sepals are short and seem to be open when the capsule is fertilized. Even late in fall there may often be found what seem to be cleistogamous flowers, with one to several minute whitish petals. In fact the budlike closed cleistogamous flowers of this species do not seem to be as fertile as they are in the rest of the violets, and appear to fall off aborted before producing seed. They are reproduced at the end of the shoots and are short-stalked apical and sometimes in old leaf axils.

The cleistogamous flowers of *Viola rostrata* are among the first to appear and continue to develop until winter. The sepals are at first and before fertilization somewhat unequal. The peduncle is not bent and this is the case in all the plants of the caulescent group. The stamens are five in number. They grow usually from the ends of the stems which do not elongate much;

they are at first rather long and slender peduncled and become shorter late in season. The apetalous flowers are not produced by transition from the petaliferous ones but appear immediately in their characteristic form.

Viola striata Ait., resembles the preceeding in the number of stamens. The sepals have long auricles that are characteristic of the plant. The sepals are very unequal, the inner being much shorter than the two or three outer ones. The transition to cleistogamous flowers is rather more gradual but not so much so as in *V. canadensis* Linn. The styles and stigmas of the caulescent cleistogamous flowers are usually nearly straight somewhat expanded above or but very little reflexed.

Viola pedata Linn., stands in a class by itself as having no cleistogamous flowers. The following key shows the relationship of the proposed segregates. No species will be transferred by us unless such as we have examined and the number of stamens determined. Moreover, no species will be mentioned in *Viola* proper unless this fact of the presence of two stamens has been determined.

KEY TO GENERA AND SUBGENERA

A. Plants acaulescent, the leaves and flowers of both kinds either directly from rootstock or runners.
  (a) Cleistogamous flowers none. . . . . Genus **Oionychion** (type *V. pedata* Linn.)
  (a) Cleistogamous flowers present in summer after the vernal petaliferous ones. . . . . Genus **Viola** (type *V. odorata* Linn.)
    (b) Rootstock thick, plants with stolons, petals blue, the lateral bearded. . . . . Subgenus **Euion** (type *V. odorata*).
    (b) Rootstock thick, plants without stolons, petals blue,[1] the lateral bearded. . . . . Subgenus **Hesperion** (type *V. palmata*).
    (b) Rootstocks, slender, plants from and with stolons, petals white or pale lilac.[2] . . . . Subgenus. **Verbasculum** [old Genus] (type *V. primulaefolia* Linn.)
A. Plants caulescent, flowers axillary.
  (a) Cleistogamous flowers present appearing after the petaliferous later in the season. Plants perennial.
    (b) Stamens of the cleistogamous flowers two, petaliferous flowers yellow. . . . . . Genus **Crocion** (type *V. pubescens* Ait.)
    (b) Stamens of the cleistogamous flowers five, petaliferous flowers white, purplish or blue. . Genus **Lophion** (type *V. canadensis* Linn.)

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[1] White in *Viola candidula*.

[2] *Viola rotundifolia* Michx. with yellow flowers may perhaps form another subgenus.

(c) Lower petal spurred, flowers violet blue. Style not capitate. . Subgenus **Eucentrion** (type *V. rostrata*) Pursh.
(c(Lower petal not spurred, flowers not blue, white within, base yellow. Style capitate. Subgenus **Eulophion** (type *V. canadensis* Linn.)
(c) Lower petal spurred. Flowers white or cream colored. Style not capitate Subgenus **Rhabdotion** (type *V.striata* Ait.)
(a) Cleistogamous flowers absent. Plants annual or biennial Genus **Mnemion**[1] (type *V. tricolor* Linn.)

Onionychion Gen. Nov. Viola Linn. pro parte.

Planta acaulescens ramulos stoloniferos carens, radicibus fibrosis rhizomate praemorso, carnoso, erecto, brevi, vel cormo elongato, stricte simplice nunquam ramoso; floribus cleistogamis nullis, vernalibus autem magnis purpureis; foliis vernalibus parvis, subpedate 5-9-partitis, laciniis latioribus; aestivis vero linearibus longioribus et angustioribus cum pedunculo flores multo excedente, 4-angulato. Stamina cum appendicibus magnis, antheris sessilibus, bina inferiora caudata, inferius obtuse plus minusve calcaratum. Petala non barbata. Stylus clavatus erostratus, apice oblique concavus, cum stigmate in tuberculo parvo, quod eodem medio apice concavo inclusum est.

Acaulescent stolonless plants with fibrous roots without aestival cleistogamous flowers and with large showy purplish vernal ones. Rootstocks short, premose, erect, or elongate cormlike, unbranching. Leaves of two kinds, small early ones broad-lobed less dissected. Orange stamen tips large, or obovate, anthers sessile the two lower with a curved projection into the more or less saccate spur. Style club-shaped, beakless, obliquely concave at the summit. Stigma within a small protuberance near centre of cavity. Petals all beardless entire. Peduncles somewhat 4-angled much longer than leaves.

Oionychion pedatum (Linn.) Comb. Nov.

Viola pedata Linn. Sp. Pl. p. 933, (1753).

Oionychion pedatum var. **inornatum** (Greene).,

Viola pedata var. *inornata* Greene Pitt. III., p. 35, (1896).

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[1] The name *Ion.* Medicus Malv. p. 102, (1787), is probably only a synonym for the Linnaean *Viola,* and not meant as a segregate of the pansies from the genus. The name was a synonym before Linnaeus and is but the literal Greek translation of the Latin Viola. *Ion arvense* would be less appropriate than *Mnemion arvense.* We therefore reject the name in favor of the later *Mnemion* Spach.

Oionychion pedatum var. **ampliatum** (Greene).

Viola ampliata Greene. Leaflets Bot. Obs. Crit. I, p. 3, (1903).

The habit of these plants and their petaliferous flowers as well as lack of cleistogamous flowers, and peculiar structure and shape of stigma and style, even the cormlike erect rhizome which never branches, together with the other characters mentioned mark these plants as very distinctly different from any of the other violets. The habit of these plants could perhaps be more considered as that of a perennial stemless pansy, than a violet proper. The absence of cleistogamous flowers emphasizes this so much that the earlier botanists before Linnaeus referred the plant called *Viola pedata* Linn., to *Viola tricolor*, or a stemless pansy, calling it "*Viola tricolor, caule nudo foliis tenuius dissectis*"[4] or "*Viola virginiana, foliis multifidis cauliculo aphyllo.*"[5]

The name *Oionychion* comes from the Greek words οἰωνὸς, bird, ὄνυζ, ὄνυΧος, claw, ἴον, violet.

VIOLA (Vergil, Pliny) Linn. Sp. Pl. p. 933, (1753).

Subgenus EUION.

VIOLA ODORATA (Tragus) Linn., Sp. Pl. p. 934, (1753).

Viola purpurea Pliny, Hist. Nat. XXI.: 6, also Ruellius, Nat. Stirp. 633, 49, (1543), etc., etc.

Viola martia Gall. ex. Ruellio l. c.

Viola nigra Vergil 4: 120; also Brunfels, Herb. Viv. Ic. p. 137, (1530).

Viola officinarum Ruppius.

We have not been able to secure good cleistogamous flowers of this plant for study.

Subgenus HESPERION

VIOLA FIMBRIATULA J. E. Smith in Rees' Cyclop. Vol. 37, No. 16, (1817).

Viola ovata Nutt. Gen. Vol .I.: 148, (1818).

Viola sagittata var. *ovata* T. and G. Fl. N. A. Vol. I. p 133, (1838.)

The auricles of the sepals of the apetalous flowers are as long almost as in *V. cucullata*. Specimens from Mineral Springs (Porter Co.), Ind., were examined. Flowers sometimes especially late in season have a small spatulate whitish or bluish keel petal and one or two small abortive lateral petals. Stamens two. Once only was one found that had a third subabortive stamen with only one anther that appeared fertile. This anther being the only one found of many examined, it was thought to be a case of teratology.

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[4] Banist, J., in Ray. J. Hist. Pl. II. p. 1928, (1688).

[5] Plukenett, L., Alm. p. 388, t, 114. f. 7, (1696).

VIOLA CUCULLATA Ait. Hort. Kew. 3 p. 228, (1789).

Though the cleistogamous flowers very often have one to three petals, never have more than two fertile stamens been found. The keel petal is spatulate bluish, larger than in the two preceeding, the lateral always linear though often expanded slightly at the colored tip. The cleistogamous flowers have long auricles and not infrequently a stiped aborted ovary is found within the mature fertile one arising from the middle of the torus.

VIOLA VARIABILIS Greene.

Cleistogamous flowers on prostrate branches purplish, auricles very short, fruit ovoid or obovoid, stamens two.

The earliest leaves are reniform crenate and vary to such as our palmately dissected into linear branching lobes. Stamens often with four anthers seldom three, one of which may be aborted.

VIOLA PALMATA Linn. Sp. Pl. p. 933, (1753).

Specimens from woods S. E. of Notre Dame were examined. It grows with *V. variabilis* Greene and *V. populifolia* Greene.

The summer flowers always have but two stamens. In shape these resemble those of the cleistogamous flowers of the preceding.

VIOLA POPULIFOLIA Greene. Pitt. Vol. III. p. 337, (1896–1898).

Cleistogamous flowers were collected and examined from St. Mary's ravine, Notre Dame, Ind. and Studebaker's woods, South Bend. Examinations in the field were made in the aforesaid places. The plant is very common and produces prostrate cleistogamous flowers sometimes subterranean or at least under leaves and decaying vegetative matter. All the flowers were found to have invariably two fertile stamens.

VIOLA PAPILIONACEA. Pursh. Pl. Am. Sept, Vol. I. 173, (1814).

Plants growing on the edge of the water line of an "Ox-bow-loop" of the St. Joseph River near St. Mary's academy were examined. The plants at high water mark are not infrequently submerged early in spring and accordingly bloom later, while the flowers are paler often lilac or lavender colored. The stamens of the cleistogamous flowers are two always. Other flowers from plants near Terre Coupée showed similar characters.

VIOLA CUSPIDATA Greene, l.c.Vol. III., Pitt. p. 314, (1896–1898).

Cleistogamous flowers have never been found to have more than two stamens. Rather common plant in the woods of our region. More material of this plant was collected and examined than of any other violet here noted.

VIOLA AFFINIS Le Conte Ann. Lyc. N. York, II. p. 138, (1828).

Cleistogamous flowers of plants from Four Mile Bridge north of Notre Dame were examined. The stamens are always two.

VIOLA CANDIDULA Nwd. Am. Mid. Nat. III., No. 4. p. 85 (1913)

For details of apetalous flowers consult reference cited. Stamens never more than two. The supposed abortive stamen mentioned on page 91 is really the keel or lower petal as elsewhere noted.

VIOLA SAGITTATA Ait. Hort. Kew. 3 p. 287, (1789).

Specimens from Webster's crossing (two separate localities) were examined. The plants invariably have cleistogamous flowers with only two stamens. The cleistogamous flowers of *V. sagittata* are characterized by the long auricles of the sepals almost as in *V. cucullata*. The flowers are at first strictly erect on erect peduncles but about the time of fertilization become recurved, and at the time of dehiscence become again erect.

Subgenus *VERBASCULUM* (Genus of the ancients.)

VIOLA LANCEOLATA Linn. Sp. Pl. p. 934 (1753).

Flowers from plants were examined from various places. Those collected in Brookland, D. C. in summer had but two stamens. Plants collected early in the season at Crumstown and Webster's Crossing, north of Notre Dame, had no trace of petals. From the same place in fall as also from Mineral Springs, the lower petal and traces of lateral petals were sometimes found. Pollen tubes were found in this species as also in *V. primulaefolia* Linn.

VIOLA PRIMULAEFOLIA Linn. Sp. Pl. p. 934, (1753).

Plants were collected in the summer of 1913 near a spring not far from Terra Cotta, D. C. A considerable amount of cleistogamous flowering material was examined at the time and some preserved for histological study. The stamens were invariably only two.

VIOLA INCOGNITA Brainerd.

Specimens examined both from Mineral Springs (Porter Co.) in fall and from Crumstown, Ind. (St. Joseph Co.) The cleistogamous flowers have short auricles. The stamens are always two only. The keel petal is sometimes present as a spatulate semimembranous growth. The capsules and sepals are mostly purplish dotted especially late in season.

VIOLA PALLENS (Banks) Brainerd. Rhodora 7, p. 247, (1905).

Specimens of cleistogamous flowers from Crumstown invariably have but two stamens. No petals were found. Plants at Mineral Springs agree in this respect.

Crocion Nov. Gen.

Type Species *Crocion pubescens* or *Viola pubescens* Ait. Hort. Kew. ed. I., Vol. III., p. 290, (1789).

Plantae caulescentes rhizomate carnoso foliis cordatis vel reniformibus, crenulatis vel dentatis, bracteolis perparvis, petalis flavis striatis, lateralibus quidem barbatis; appendicibus antherarum ovalibus; sepalis quinque, subinaequalibus auriculatis, staminibus quinque subsessilibus, binis inferioribus calcaratis, ovario oblongo vel ovali subtriangulari; staminibus florum cleistogamorum binis tantum, petalis parvis aliquando praesentibus spatulatis vel linearibus.

Caulescent plants not much branched with fleshy rhizomes; leaves cordate or reniform crenulate usually not numerous, the upper short and stalked, the lower with long petioles especially the radical ones; stipules not much dentate or entire bractlets very small. Petals yellow, striate with dark veins, stamen appendages orange oval. Sepals five somewhat unequal slightly auricled. Stamens five subsessile, the two lower slightly spurred. Ovary oblong or oval somewhat triangular. Stamens of the cleistogamous flowers two only with rarely an abortive third. One to three abortive petlas often present. The lower spatulate or linear, the lateral linear petals flat.

Crocion eriocarpum (Schwein) Nov. Comb.

Viola eriocarpa Schwein. Am. Jr. Sci. 5. p. 75, (1822).

Viola pubescens var. *scabriuscula* T. & G. Fl. N. Am. 1, p. 142, (1838).

Viola scabriuscula Schwein Britton and Brown Ill. Fl. 2, p. 453, (1897).

Though this and the following violet are caulescent, and the stemmed violets have ordinarily five perfect stamens in their cleistogamous flowers, these so called yellow violets have only two. One or two extra abortive stamens are not unfrequently found but not more than two perfect ones with both anthers.

In a single instance was a third stamen found with an anther having a few pollen grains and the other anther aborted to a capitate gland. The lower petal and one or two lateral ones are occasionally met with.

Crocion pubescens (Ait.) Nov. Comb.

Viola pubescens Ait. Hort. Kew. 3, p. 290, (1789).

Principally because of this remarkable difference in the number of the stamens of the yellow caulescent violets are they here segregated. Though the number of stamens in the cleistogamous flowers of *Chrysion biflorum* (Linn.) Spach could not be studied we can not refer the American plants to Spach's genus where they might be thought to belong by habit and other characters. There are, however, differences warranting their being taken out of this genus and put in a new one. More detailed study of the cleistogamous flowers of all the violets alone can decide the standing of those. The stamens in *Crocion pubescens* are only two!

LOPHION Spach, Hist. Nat. Veg. V. p. 516, (1836).

Viola Linn. l. c. seg.

The cleistogamous flowers of Lophion in the division *Eulophion* do not appear immediately after the season of flowering of the other violets but are a gradual evolution of the spring petaliferous ones. The petals become smaller and finally disappear leaving occasionally only the lower petal, sometimes two lateral ones and often all are wanting. Many of the cleistogamous flowers are abortive, *stamens are always five*, fertile, spatulate, with the terminal appendage shaped nearly as in those of the other groups. Plants of the group of *V. rostrata* cease to bloom soon and produce cleistogamous flowers all the rest of the year until snowfall.

Type *Viola canadensis* Linn.

EULOPHION.

LOPHION CANADENSE Spach, l. c. p. 517.

Viola canadensis Linn. Sp. Pl. p. 936, (1753).

The sepals of the cleistogamous flowers are rather unequal usually, the inner being shorter, all at first firmly pressed against the ovary and stigma, later after fetilization open early, especially at the tips, leaving the apex of the ovary exposed while the five stamens and the petals fall off. Petals which are usually greater, in number (often five), and larger comparably than in the other violets, are not uncommonly present. It is therefore quite inappropriate to call these aestival flowers apetalous, and more correct to call them cleistogamous.

Subgenus **Eucentrion.**

Lophion rostratum (Push.) Nov. comb.

Viola rostrata Pursh, Pl. Am. Sept. p. 174, (1814).

Cleistogamous fruit subglobose obtusely triangular, the carpels broadly carinate, with a slight small channel like depression running from base to apex. Style rather long, recurved at the apex. Sepals subequal lanceolate, glabrous with a rounded short auricle. Later flowers sometimes possessing 1—several lanceolate petals about ¼ the length of the free upper end of the sepals. Stamens 5 spoon-shaped, spatulate, fruit and ovaries erect on their peduncles, produced at the ends of the branches all summer and fall until winter.

Subgenus **Rhabdotion.**

Lophion striatum (Ait.) Nov. comb.

Viola striata Ait. Hort. Kew. 3, p. 290, (1789).

Cleistogamous flowers somewhat erect on their peduncles, *with five stamens;* these flowers sometimes with small or abortive petals in transition early in summer. Transition flowers fewer and stages more abrupt; sepals rather long very unequal, the outer longest, linear lanceolate with appendages at insertion giving them a hastate to sagittate appearance, these small appendages are wanting in the inner sepals. Sepals ciliate on margin with long, broad, spreading auricles erose-ciliate, at the free end somewhat pubescent. Style and stigma short closely appressed by the 5 imbricate stamens. Petals in the later summer cleistogamous flowers mostly absent. The anthers of all the cleistogamous flowers of violets are with scarcely any exceptions *two only, instead of four, seldom three!*

MNEMION Spach Hist. Nat. Veg. 5, 510, (1836).

Sufficiently important diagnosis will be seen to be included in the key to the genera at the beginning of this study.

MNEMION TRICOLOR Spach. Hist. Nat. Veg. 5 p. 515, (1836).

Viola tricolor Dodonaeus, Coron. p. 17, (1568). Pempt, p. 158, (1583) also Linnaeus Sp. Pl. p. 935, (1753).

Mnemion arvense (Murray) Nov. Comb.

Viola arvensis Murray, Prodr. Stirp. Goett. p. 73, (1770).

Mnemion Rafinesquii (Greene) Nov. comb.

Viola tenella Muhl. Cat. 26, (1813). Not Poiret (1810).

Viola Rafinesquii Greene, Pitt. IV. p. 9, (1899).

In conclusion we feel that the characters of the cleistogamous flowers of the plants known as violets seem sufficient to warrant the segregation suggested. We have refrained, however, from making any transfers of the numerous species of the groups because we were unable to examine the flowers of them all. We have reason to feel confident that the event may more than prove the suggestion here outlined, and should this be the case the study of violets by their cleistogamous flowers will further the knowledge thereof, and give us at least a very good means of distinguishing the groups.

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NOTES ON OUR LOCAL PLANTS.—V.

BY J. A. NIEUWLAND.

Subclass 2. DICOTYLEDONEAE.

D. C. Syst. I., (1818), also Prodr. I., p. 1, (1824).

Dicotyledones Haller Enum. Pl. p. XXI., (1753); also Boerhaave Index. Pl. Alt. 2, p. 171, (1727.)

Order 15. PIPERINAE.

Bartling, Ord. Nat. p. 83, (1830).

Piperales Engl. Syllab. p. 93, (1892), also Engler and Prantl. Pflanzenfam. Nachtr. p. 345, (1897).

Family 37. **SAURUREAE** Rich. Anal. (1808), Bartling, l. c. p. 84, also Lindley, Int. Veg. Syst. p. 172, (1830).